



RENEWABLES FOR SUSTAINABLE  
VILLAGE POWER

# PROJECT BRIEF

## Hybrid Power Systems for Russia's Northern Territories

by C. Dennis Barley and Vahan Gevorgian 12/97

### Background

In the northern areas of Russia (including the Kola peninsula, the Arkhangelsk region, the Chukotka peninsula, and other locations), a number of lighthouses, small industrial villages, and meteorological station facilities receive electric power from one of two sources. An existing grid serves a portion of the area and small, local diesel power plants serve the remaining locations. In some cases, the reliability of the grid service is deemed unacceptable and local independent power stations are desired. As for the small diesel plants, diesel fuel prices in northern Russia range from about \$0.36/liter to \$1.30/liter, and the demand for electricity often exceeds available fuel supplies.

These conventional power issues are helping to open up a market for renewable energy sources. The wind resource in northern Russia is very good, particularly in the Murmansk and Arkhangelsk regions. The estimates of the annual average wind speed for those regions range from 7 to 9.5 m/s for the coastal areas and from 4 to 7 m/s inland. Most of the territories lie near or north of the Arctic Circle, so icy conditions and permafrost ground are concerns.

### Scope

The United States Agency for International Development (USAID) has provided \$1.4M for the purchase of 40 Bergey Windpower wind turbines (10 rated at 1.5 kW and 30 rated at 10 kW), batteries, solid-state power converters, and other equipment for retrofitting hybrid systems with existing diesel plants. Candidate project sites were selected on the basis of the infrastructure necessary to maintain the systems, the wind resource at the site, the fuel price and availability at the site, and a variety of applications to serve as pilot projects. The U.S. team provided systems designs, equipment and training of local technicians in installation and maintenance.

### Status

Based on a preliminary assessment of loads, wind speeds, and fuel prices, analysis at National Renewable Energy Laboratory (NREL) indicated that optimally cost-effective hybrid retrofits

for roughly six villages and ten smaller projects could be fashioned from the set of equipment provided with the USAID funds. During the summer of 1997, two Russian engineers spent two months with the NREL team using the *Hybrid2* simulation model for the analysis of hybrid systems for northern Russia. Upon their return to Russia, they became key members of a Russian team that consists of specialists representing the Russian Ministry of Fuels and Energy, the Federal Center of Small and Nontraditional Energy, and the Intersolarcenter.

Two hybrid systems, both in the Arkhangelsk region (two 10-kW turbines at Krasnoe village and one 10-kW turbine at Bolshie Kozli village), were installed from September to December 1997. Two more 10-kW turbines are being installed in the Arkhangelsk region at Megra village, four 10-kW turbines are going in at Chukotka and sites for four 10-kW turbines are under preparation in the Murmansk region.

The Bergey team provided a two-week installation and operations and maintenance training seminar for local engineers and technicians in October and November of 1997. Planned activities for the project team and partners include continuing to gather information, perform analysis and system design, and install and monitor systems.

### Team/Partners

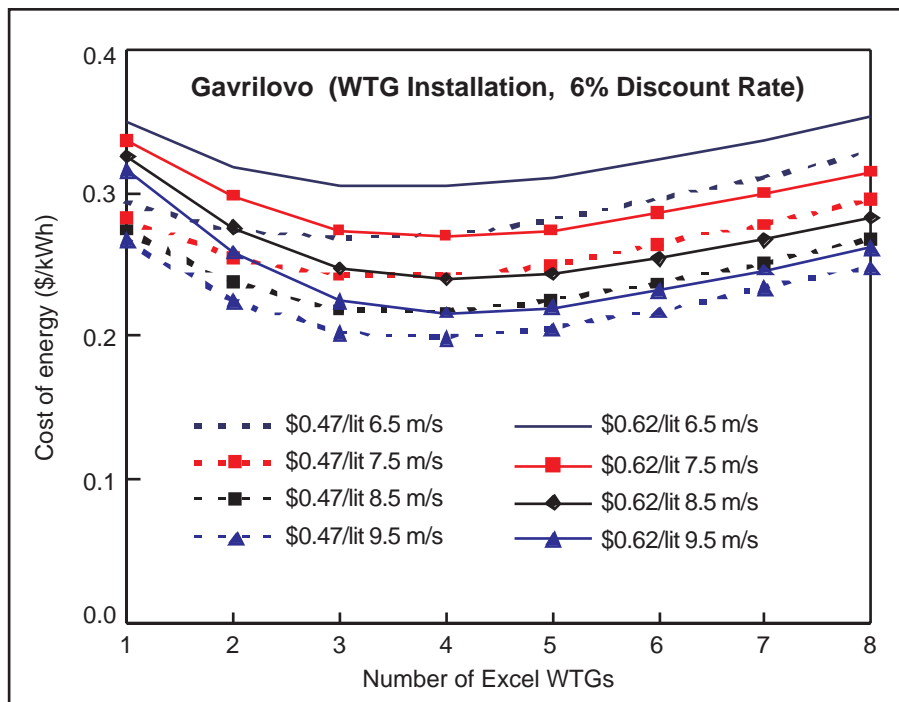
- Russian Ministry of Fuels and Energy
- Intersolarcenter
- Federal Center of Small and Non-traditional Energy
- Darup Associates

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*This graph illustrates a study of the least-cost sizing of a wind turbine array for a sample small village, based on preliminary data and analysis, with fuel price and wind speed as parameters. Similar studies were conducted for a number of villages and meteorological stations.*

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